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AUTHOR Cajete, Gregory A.
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ABSTRACT

Explanations of natural phenomena within a traditional Native American context are often at odds with Western scientific philosophy and what is taught in school science. Herein lies a very real conflict between two distinctly different worldviews: the mutualistic/holistic-oriented worldview of Native American cultures and the rationalistic/dualistic worldview of Western science that divides, analyzes, and objectifies. General tendencies in Native learning styles include a predominantly nonverbal orientation; tendency toward visual, spatial, and kinesthetic modes of learning; heavy reliance on visual perception and memory; preference for movement and activity while learning; and preference for process learning that moves from concrete examples to abstractions. In the typical school environment, free movement is significantly restricted and indirect intellectual learning, which emphasizes verbal, mathematical, and logical orientations, is the norm. The disparity between home and school environments is so great that some Native American students experience a kind of culture shock that significantly affects their attitudes toward school. Recognizing that a cultural difference in affective learning style exists between the home and school environment is an important step toward developing more creative and effective teaching strategies for Native learners. Teachers can foster a bicultural orientation to education by exploring students' home and cultural backgrounds, observing students in the school context, and exploring students' expressions of core values. Contains references in endnotes and a bibliography. (TD)

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CHAPTER 6

The Native American Learner and Bicultural Science Education

GREGORY A. CAJETE[1]

Cultural revitalization and restoration has resulted from education from a Native perspective. This has been one of the positive aspects of the educational emphasis upon Native language and culture which has remained vibrant despite all efforts to change our institutions.

—Bea Medicine, "Contemporary Cultural Revitalization"

Understanding the nature of the Native American learner must guide efforts to improve the education of Native Americans. To this end, studies concerning how best to educate Native Americans have been conducted since the 1960s.[2] These studies have advocated comprehensively exploring the unique and culturally conditioned learning characteristics of Native Americans and applying such research to improving Native American education. Unfortunately, few of these studies have focused on the distinct culturally conditioned learning characteristics of Native Americans. Instead, most approaches have attempted to adjust Native students to the learning norms most valued within mainstream American education. Basing their approach on the assumption that Native American children suffer from *cultural deprivation*, educators have

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attempted to change the learning style of Native Americans through *educational reconditioning*, in this way helping students conform to the mainstream education system. The record of Native American education—from the earliest missionary attempts to the boarding school era to public schooling in the mid-1980s—shows the prevalence of such attempts.

Fortunately, with the new emphasis on *self-determination* and the concurrent onset of Native American cultural revitalization, this situation has slowly begun to change. However, to strengthen the movement toward more culturally relevant and learner-sensitive educational approaches, some important factors must be considered.

Native Americans have undergone periodic adaptations of language and culture during the 1900s. The nature and degree of this transition varies according to individual, social, and environmental circumstances. Many Native American students can be classified as being English dominant in their language usage. Many have encountered in their homes and communities varying degrees of traditionalism in interpreting the natural world. Some identify strongly with both the cultural and linguistic revitalization of their particular tribal group. These factors have important ramifications for teaching science to such students. For instance, identifying with tribal roots can strongly motivate students to learn about science and its role in some aspect of their tribal heritage.

While some students are rediscovering their tribal identities, others are truly bilingual and bicultural. With these students, the bicultural approach to science is equally important, but for different reasons. Such students generally want to continue to learn and live within the context of both cultures. Instruction in bicultural science for these students can result in a positive attitude toward science and reaffirmation of their tribal identity. Another reason to use a bicultural approach to science instruction is that it provides a way to bridge differences in worldview concerning natural phenomena.

Native American Valuing in Transition

For Native Americans, participation in the U.S. education system has always presented the challenge of coming to terms with two distinctly different value orientations. The psychological conflict

that can result often lies at the heart of poor academic achievement by a large number of Native Americans.

Successful learning is tied to the degree of personal relevance the student perceives in the educational task. The basis for this premise stems from the idea that motivation toward any pursuit is energized by the individual's own constellation of personal and sociocultural values.[3] A Native student's constellation of values has ancient and well-developed roots in the tribal social psyche. It is because of these deep-rooted values that unconscious aspects of Native American social personalities remain so durable and relatively visible through layers of acculturation. Understanding and using this cultural constellation of values can provide the key to motivating Native Americans to learn science.

Research from a variety of sources supports the notion that an insightful, well-integrated, and consistent cognitive map and worldview leads to a healthy concept of self and positive social adjustment. The opposite condition is usually apparent when chronic inconsistencies and conflicts arise between the internal constellation of values and those of the external social environment. The accelerated rate of change in Native American cultures since World War II has increased the inconsistences in worldview and cognitive mapping in the social, cultural, and psychological fabric of Native American life. As a result, many people experience tremendous internal tension. Chronic cultural conflict has given rise to a variety of emotional and social problems, the ramifications of which are poorly understood.

Understanding the core cultural values of Native American tribal groups, and how such values differ from the implied values inherent in American education, is essential to bicultural education. But what exactly are these core values, where do they reside, and how are they involved in the current transition of Native American valuing? The following example from Pueblo Indian philosophy may illustrate the origins of a particular set of Native American core values.

According to Torey Purley of Laguna Pueblo, in Keresan Pueblo Indian philosophy, the mythological being, Thinking Woman plays an important role in the process of human valuing. Thinking Woman orders the universe by maintaining the balanced interrelationship among four worlds of being. The first world involves the collectivity

of prior human experience (similar to Carl Jung's collective unconscious). The second world involves learning and the development of the individual. The third world involves the development of thinking, especially at its higher levels. The fourth world synthesizes all life within oneself, the individual life cycle. These worlds are so intertwined there is perpetual movement of our being in each world simultaneously.[4]

In contrast to the notion of some scholars that Native American cultures tend not to conceptualize abstractly, one can see that the Keresan philosophical concept of Thinking Woman is highly abstract. In fact, the example of Thinking Woman as an abstract concept requiring very creative conceptualization is characteristic of the traditional worldviews underlying most Native American philosophies. In addition, constructs such as Thinking Woman directly influence the traditional, spiritual, and intellectual valuing within the framework of the traditional culture. F. Strum and Purley explain, for instance, that two interrelated valuing processes are involved in the concept of Thinking Woman and the four worlds of being. The first is called *Ma-shra,* which refers to immediate perceptions and the valuing therein based on the individual's experience of the immediate environment. The second is called *Shae-tah-ea,* or *like this it is,* which refers to learning by being shown and the valuing that results from such teaching. Thinking Woman can be thought of as a process and frame of reference upon which core cultural values are formed. The goal of such a valuing process is to achieve a balance of those things that are valuable to the life and harmony of the Keresan.

Thinking Woman represents an ideal philosophical construct from which traditional values of the Keresan are expressed. However, the increasing assimilation of U.S. mainstream values by Pueblo Indians is greatly changing this traditional framework for valuing. Other Native American cultures are experiencing similar transformations.

One can say in reference to contemporary Pueblo Indian valuing that four categories are reflected in the personal value constellation of individuals. These include the Pueblo-Indian-that-is, the Pueblo-Indian-in-transition, the newfound-Pueblo-Indian, and the Pueblo-Indian-that-isn't. The Pueblo-Indian-that-is lives life according to a set of values firmly rooted in the traditional Pueblo mind-set. The

Pueblo-Indian-in-transition lives according to value sets of both the traditional Pueblo culture and mainstream society. The newfound-Pueblo-Indian is usually an individual who has not been raised in a Pueblo context and is consciously in search of his or her traditional roots. The value set of this group is externally and acutely oriented to an idealized standard of traditional Pueblo culture. The Pueblo-Indian-who-isn't, for a variety of environmental and personal reasons, has consciously decided to adopt mainstream cultural values.[5]

In reality, the above categories depend on local circumstances, and an individual may alternate among the value orientations during different phases of his or her life. Human cultural valuing is a dynamic ever-evolving process, and human cognitive development does not fit neatly into categories. However, the example of Thinking Woman and Pueblo valuing illustrates the kinds of value sets characteristic of all Native American cultures and individuals existing within contemporary American society.

Pueblo Indians are among the most tenacious of American Indians in preserving their traditional culture. Yet, even among the Pueblos, the transition of values directly affects attitudes toward education. The core cultural values of Native Americans and their resultant influences on attitudes and behaviors are relatively submerged since such values tend to operate at the subconscious level. It is this characteristic subconscious influence of core cultural values that must be addressed by any educational strategy.

Because core values invariably affect education outcomes, it is important that the teacher, teaching methods, and curricular content reflect this dimension of the learner. It follows, then, that an effective and natural way for learning to begin is to help students become aware of their core values. This can be accomplished when the teacher shows the students how the content presented in a particular subject area (such as science) is relevant to or otherwise enhances an understanding of the students' core cultural values.

A student's core cultural values can act as psychological *energizers* powering the development of a positive self-image. In a bicultural approach to education, helping students bring core cultural values into their conscious awareness for examination is a transformational necessity. This process sets the stage for students to synthesize creatively and interpret these values in new and psychologi-

cally rewarding contexts. Based on these assumptions, recognizing the core cultural value structure of students becomes a powerful learning aid if teachers use this insight into their students' minds and lives in creative and constructive ways.

Traditional Native American Values and Behaviors

The following paragraphs draw contrasts between selected and widely shared Native American core cultural values and non-Native American values and associated behaviors and attitudes. These brief descriptions are somewhat idealized. They cannot reflect the wide variations within Native American communities that result from different levels of cultural assimilation among individuals nor the differences among various Native American cultures across the North American continent; yet, these values are common enough that readers may have encountered them already.

Personal differences. Native Americans traditionally have respected the unique individual differences among people. Common Native American expressions of this value include staying out of others' affairs and verbalizing personal thoughts or opinions only when asked. Returning this courtesy is expected by many Native Americans as an expression of mutual respect.

Quietness. Quietness or silence is a value that serves many purposes in Indian life. Historically the cultivation of this value contributed to survival. In social situations, when they are angry or uncomfortable, many Indians remain silent. Non-Indians sometimes view this trait as indifference, when in reality, it is a very deeply embedded form of Indian interpersonal etiquette.

Patience. In Native American life, the virtue of patience is based on the belief that all things unfold in time. Like silence, patience was a survival virtue in earlier times. In social situations, patience is needed to demonstrate respect for individuals, reach group consensus, and allow time for "the second thought." Overt pressure on Indian students to make quick decisions or responses without deliberation should be avoided in most educational situations.

Open work ethic. In traditional Indian life, work is always directed to a distinct purpose and is done when it needs to be done. The nonmaterialistic orientation of many Indians is one outcome of

this value. Only that which is actually needed is accumulated through work. In formal education, a rigid schedule of work for work's sake (busy work) needs to be avoided because it tends to move against the grain of this traditional value. Schoolwork must be shown to have an immediate and authentic purpose.

Mutualism. As a value, attitude, and behavior, mutualism permeates everything in the traditional Indian social fabric. Mutualism promotes a sense of belonging and solidarity with group members cooperating to gain group security and consensus. In American education, the tendency has been to stress competition and work for personal gain over cooperation. The emphasis on grades and personal honors are examples. In dealing with Indian students, this tendency must be modified by incorporating cooperative activities on an equal footing with competitive activities in the learning environment.

Nonverbal orientation. Traditionally most Indians have tended to prefer listening rather than speaking. Talking for talking's sake is rarely practiced. Talk, just as work, must have a purpose. Small talk and light conversation are not especially valued except among very close acquaintances. In Indian thought, words have a primordial power so that when there is a reason for their expression, it is generally done carefully. In social interaction, the emphasis is on affective rather than verbal communication. When planning and presenting lessons, it is best to avoid pressing a class discussion or asking a long series of rapid-fire questions. This general characteristic explains why many Indian students feel more comfortable with lectures or demonstrations. Teachers can effectively use the inquiry approach, role playing, or simulation to demonstrate they have a full understanding of this characteristic.

Seeing and listening. In earlier times, hearing, observing, and memorizing were important skills since practically all aspects of Native American culture were transferred orally or through example. Storytelling, oratory, and experiential and observational learning were all highly developed in Native American cultures. In an education setting, the use of lectures and demonstrations, modified case studies, storytelling, and experiential activities can all be highly effective. A balance among teaching methods that emphasize listen-

ing and observation, as well as speaking, is an important consideration.

Time orientation. In the Indian world, things happen when they are ready to happen. Time is relatively flexible and generally not structured into compartments as it is in modern society. Because structuring time and measuring it into precise units are hallmarks of public schools in the United States, disharmony can arise between the tradition-oriented Indian learner and the material being presented. The solution is to allow for scheduling flexibility within practical limits.

Orientation to present. Traditionally most Indians have oriented themselves to the present and the immediate tasks at hand. This orientation stems from the deep philosophical emphasis on *being* rather than on *becoming*. Present needs and desires tend to take precedence over vague future rewards. Although this orientation has changed considerably over the past 40 years, vestiges are still apparent in the personalities of many Native Americans. Given this characteristic, the learning material should have a sense of immediate relevancy for the time and place of each student.

Practicality. Indians tend to be practical minded. Many Indians have less difficulty comprehending educational materials and approaches that are concrete or experiential rather than abstract and theoretical. Given this characteristic, learning and teaching should begin with numerous concrete examples and activities to be followed by discussion of the abstraction.

Holistic orientation. Indian cultures, like most primal cultures, have a long-standing and well-integrated orientation to the whole. This is readily apparent in various aspects of Indian cultures, ranging from healing to social organization. Presenting educational material from a holistic perspective is an essential and natural strategy for teaching Indian people.

Spirituality. Religious thought and action are integrated into every aspect of the sociocultural fabric of traditional Native American life. Spirituality is considered a natural component of everything. When presenting new concepts, teachers should keep in mind that all aspects of Indian cultures are touched by it. Discussing general aspects of spirituality and religion is an important part of the

curriculum, although precautions must be taken to respect the integrity, sacred value, and inherent privacy of each Indian tribe's religious practices. Ideally all discussions of Native American religion should be kept as general and nonspecific as possible. Specifics should be discussed only in the proper context and with the necessary permission of the particular tribe involved.

Caution. The tendency toward caution in unfamiliar personal encounters and situations has given rise to the stereotypical portrayal of the stoic Indian. This characteristic is closely related to the placidity and quiet behavior of many Indian people. In many cases, such caution results from a basic fear regarding how their thoughts and behavior will be accepted by others with whom they are unfamiliar or in a new situation with which they have no experience. Educators should make every effort to alleviate these fears and show that students' subjective orientations are accepted by the teacher. To the extent possible, the class and lesson presentation should be made as informal and open as possible. Open friendliness and sincerity are key factors in easing these tensions.

Classroom discipline. Most Indian people value the cultivation of self-discipline and rarely resort to direct punishment or demeaning personal criticism. Behavior is regulated through group and peer pressure. Withdrawing approval, expressing shame, and reflecting unacceptable behavior back to the individual are the main forms of punishment in the traditional Indian context. In the classroom, direct and demeaning personal criticism in front of others is considered rude and disrespectful and can lead to "loss of face" and complete withdrawal and alienation by the student. Withdrawing approval and communicating clearly the consequences of breeching standard behavior are key considerations in this situation.[6]

Field-sensitive orientation (group orientation, a sensitivity for a field of social relationships). A significant number of Native Americans tend to express field-sensitive behaviors as opposed to field-independent behavioral characteristics.[7] This has direct implications for the learning styles Native Americans exhibit. The most important implications include the following: Native American learners will respond more readily to personalized encouragement coupled with guidance and demonstration from the teacher; Native American learners tend to base much of their motivation for

learning on the affective relationship with the teacher; and Native American learners tend to respond best to learning formats that are group oriented and humanized through the extensive use of narration, humor, drama, and affective modeling in the presentation of content.[8]

Implementing Bicultural Science Education

The scientific rationalistic viewpoint has become an integral part of the American education structure. This viewpoint has become so ingrained in the psyche that most Americans view reality in no other way. Because of this conditioning, science education in most schools is the subject most insensitive to the diverse sociocultural environments from which students come.

Learning is tied to the job. The following example demonstrates the differences and possible points of antagonism among European American and Native American approaches to teaching and learning science.

In Native American society, learning how to hunt is a programmed sequence of observations and experiences tied to a process:

1. learning the habits of the animal to be hunted—via mythology, listening, and observation;
2. learning how to track, read appropriate signs, and stalk the animal—via observation, intuition, and reasoning;
3. learning the appropriate respect and ritual that is to be extended to the animal—via a "mind-set";
4. learning how to care properly for the carcass of the animal once it has been taken—via an ecological ethic and technology;
5. learning how to utilize fully the various parts of the animal taken—via technology.

All of these processes require a variety of teaching techniques that range from formal instruction to experiential learning by doing. They must take place within a particular contextual framework necessary for conveying these forms of knowledge.[9]

This type of learning is directly tied to the job or activity to be completed and involves teaching to accomplish a specific goal. Stu-

dents learn much by careful observation. Within this traditional process of teaching and learning, teachers are many, and situations are numerous. Learning how to hunt becomes a part of the life cycle of the Native American individual and community. In Native American cultures, education is grounded in the challenge of learning practical skills and knowledge in a real-life context.

Modern European American education, however, imparts to students conceptual frames of reference that prepare them for future tasks deemed important in an industrial and technological society. Learning material is typically laid out in a distinct linear pattern. The curriculum is mapped out hierarchically, beginning with the objectives for each grade level and moving to more specific unit and individual lesson plans, each with their own objectives and associated learning activities.

This highly structured and programmed approach is useful in that it allows for easier teaching of large numbers of students and a greater consistency in what is learned. Yet, if one views this approach in terms of addressing individual student learning styles, many problems become apparent. When looking at Native American students with some understanding of cultural influences on learning style, the teacher encounters major difficulties with this approach.

Much of modern education involves to one extent or another imposing a preconceived psychological pattern of "right ways to do things" and "wrong ways to do things." In public schools, this pattern involves imposing a modern American societal will on all those who participate in American public education. However, in imposing such a societal will upon what is taught and how it is to be learned, many students are denied use of their own innate repertoire of intelligences and cultural styles of learning. Learning by simply doing, experiencing, and making connections that coincide with the personal and cultural intelligences and learning styles students bring with them from home can be significantly diminished through such a homogenization of the education process.

Understanding what constitutes reality for different cultural groups and establishing communication about nature that is meaningful for each are basic aims of bicultural science education. The preliminary steps toward this end necessarily begin with a careful study of how students perceive familiar natural phenomena. In reference to Na-

tive American attitudes and ideas about these phenomena, one often finds a mixture of observations based upon combinations of folk, experiential, and school-derived sources. Such observations may appear to be contradictory, and a teacher might wonder how these disparate combinations of ideas about nature can be comfortably accommodated within a single student's understanding of the world. To a non-Native American observer, this mixture of perspectives may seem to be a paradox that must be reconciled.

Studies of cognitive development, however, imply we are all capable of having more than one internally consistent mind-set concerning natural reality.[10] The conditioning of Western scientific schooling may make it seem otherwise. This conditioning of students to think in only one way regarding the explanation of natural phenomena is a key concern in enhancing creative scientific thinking because such conditioning eventually stifles creative learning.[11]

In addition, one often finds that opportunities to learn about or practice the skills necessary for Western science are not present within the student's home. This is common in many Native American households. However, this does not necessarily mean that students have not acquired skills in applying cultural knowledge to their natural environment. On the contrary, many Native American students from traditional backgrounds have gained relatively rich experiences through a variety of cultural and practical encounters with the natural environment. But the sources of knowledge of nature and the explanations of natural phenomena within a traditional Native American context are often at odds with what is learned in "school science" and proposed by Western scientific philosophy. Herein lies a very real conflict between two distinctly different worldviews: the mutualistic/holistic-oriented worldview of Native American cultures and the rationalistic/dualistic worldview of Western science that divides, analyzes, and objectifies.

In regard to this conflict, science educators have generally adopted an either/or attitude. That is, most science educators have determined that if non-Western explanations of natural phenomena do not fit the Western scientific framework, they are not scientific. This is not a new attitude. From the earliest days of missionary education to the days of Bureau of Indian Affairs (BIA) boarding school education to the present, the attitude of replacing the "primitive" beliefs of

Native Americans with the "correct" beliefs of science has been an integral part of the curriculum. Such a difference in perspective has caused much conflict in Native American students, families, communities, and schools.

What measures can science educators take to decrease the confrontation of a student's cultural worldview with that of Western science? First, introduce students to the basic skills of science. Use familiar objects or events to build upon students' innate interests and curiosity. Students then become involved with science as a process of observing, classifying, collecting information, and making generalizations with reference to phenomena they know about. Second, once students learn to apply these basic skills, compare ways in which science as a thought process is exemplified in students' particular cultures and in that of the larger society. Third, analyze various symbols as they relate to explanations of natural phenomena in both traditional culture and Western science. Teachers should not present one perspective in preference to another.

In every culture, the inherent thought process of science attempts to relate derived symbols of phenomena to one another in such a way as to develop a pattern of thought concerning those events. And while many Native American students may come from environments in which they are not exposed to, or have not developed skills required for, the established patterns of Western science, they *are* exposed to the process of making sense of natural phenomena. That is, they have some skill in relating important culturally derived symbols of phenomena within the framework of what is meaningful to them.[12]

The model, or symbolic map, of concepts representing what is important in a particular culture's natural reality is important to the way members of that culture apply the science process and develop their mind-set. In addition, much of the communication concerning natural phenomena is highly contextual in Native American cultures. That is, information concerning natural phenomena is presented in the most appropriate context by using symbolic vehicles such as art, myth, or ritual. Relationships among natural phenomena are observed and symbolically coded in a variety of forms based on experiential knowledge of the phenomena. In contrast, Western science is low context in terms of both communication and process-

ing of information. That is, information concerning natural phenomena is often highly specific, parts oriented, and presented outside of the contexts within which the phenomena naturally occur or are observed. Western science is based upon a set of relationships among concepts or theories derived from the observation of natural phenomena.[13]

Orientations for Implementation

Given the differences between the way Native American cultures and Western science apply the science process, what are some of the other considerations for implementing a bicultural approach to science? First, teachers must keep in mind there is both an ideal and a reality in the implementation of any approach to education. Both of these dimensions directly affect the way a teacher teaches science. If a teacher begins with the premise that teaching is a communicative art, one can apply the appropriate research concerning the teaching, accumulation, and learning of language to explain the complexities encountered in the classroom.

Teaching is essentially the processing and communicating of information to students in a form they can readily understand, combined with facilitating their learning and relative cognitive development. Ideally the teaching methods and information presented will be in a form that is relevant and meaningful to the students. Since language is the dominant mode of communication in teaching and learning, studies of language acquisition are important sources for understanding the dynamics of this overall process. Research shows that after a language is learned, it is initially used as the basis for learning subsequent languages. We actively engage in a gradual, subconscious, and creative process to acquire the knowledge and ability to use a language and understand its underlying assumptions and cultural frames of reference.[14]

People apparently learn a new language in two characteristic ways—through unconscious acquisition or through a more conscious process. The most natural way to learn a language requires no formal teaching. Instead, it involves *immersion* in the environment in which the particular language is spoken. The other method requires the formal study of how a particular language is structured. This in-

cludes learning grammatical rules, correctness of form, and other technical requirements.[15]

If one views science as a special kind of language for communicating information about nature, the method of learning a language has very important implications for teaching and learning science. Science can be learned the same way young children naturally acquire a whole language system by being in an environment in which that language is cultivated. This implies children must be exposed to an environment that is acquisition-rich in the language of science. Ideally both the home and school environments should offer many opportunities to practice and develop the application of the science process. However, this is rarely the case. The task becomes one of creating acquisition-rich, science-process environments in schools. Elements composing such environments might include various opportunities to encounter the natural environment: field trips; visits to appropriate museums and national or state parks; art, social science, or culturally related projects dealing with the science process; storytelling or guest speakers; hands-on activities involving science as process; and the creative presentation of science as both a discipline and a cultural system of thought.[16]

Another useful concept in understanding the acquisition of science language and literacy is the relevant-input hypothesis.[17] This hypothesis suggests that a key to acquiring a second language is a source of content that is familiar, easy to understand, interesting, and relevant to the environment of the learner. If science can be thought of as a kind of literacy, the relevant-input hypothesis suggests science has a language with content, symbol systems, and structure that can be learned very much like other second languages. The relevant-input hypothesis also suggests that we acquire new language structures through understanding messages that contain the new structures rather than being taught them directly. The implications of this hypothesis for teaching science are many. Students can learn new science constructs more effectively if they are encountered first in *messages* that contain the new constructs. That is, one can teach about science by teaching about something else and relating that something else back to a particular aspect in science. This can be done by integrating ideas and structures (or constructs) from the arts, humanities, or social sciences into the presentation of science.[18]

Further Considerations

There are several other essential elements in developing an effective approach to bicultural teaching and learning. First, the mismatch between students' home environments and the school environment is often identified as the reason for the maladjustment of Native American students to school. Most often the nature of the home environment is pointed to as the main problem. This situation has had important ramifications for both the emotional and cognitive growth of the Native American student within the school environment. The second element includes the values, religion, community, and social context from which Native American students derive their frames of reference. These factors are essential to understanding the way in which teaching/learning activities affect students. In addition, the styles of nonverbal communication used in classrooms and the social context of the school itself play important roles in shaping student perceptions of education.

The cultural mismatch between home and school has been the subject of much research in bicultural education, leading to some important insights that directly impact Native American education. For instance, researchers have found that how a minority group perceives itself as being viewed by the dominant culture often influences the self-esteem and self-concept of minority students within a particular school environment. In other words, for practically all Native American students, school represents an emotional challenge. Variations among different tribal cultures and relative levels of acculturation that Native American students bring with them from home couple with individual personality differences to form important aspects of their emotional structures.

Many Native Americans view themselves as minorities, apart from mainstream culture, because they are deemed as such by the school. The fact they are frequently looked upon as being different has had a detrimental effect on their self-images. As they grow older, they begin to perceive what is valued and not valued within mainstream culture. They realize that much of what makes up their core cultural values is not seen as valid or important, and they feel compelled to either adapt or retreat.

Native American students' awareness of this underlying bias in favor of Western values often directly affects their attitudes toward

certain school disciplines such as science. In a complex interplay among student, home, school, and community, many Native American students internalize the assumption, based on their experiences in school, that the school and the rest of mainstream society expect less of them than of non-Indian students. As a result, students expect less of themselves and adopt stereotypical images of themselves and their cultures. To counteract this scenario, educators must make a great effort to encourage and expect excellence from Native American students.

Aside from home environment and culture, language is another major element within a bicultural education program. When one views teaching as a *communicative art* and language as the most basic part of that communication, the way language is used to present content becomes an important issue. A Native American student whose first language is an Indigenous dialect may come to school with a different orientation to sound and symbol relationships and may exhibit a unique pattern of thought and style of communication. Such differences require a sensitive approach to the presentation of each subject, especially modern science since it may be the least familiar to Native American students from a traditional home environment. Science as a process of thought is learned not only in school but also through interaction in the home and with the surrounding natural environment. This affects the student's perception of modern science.

In many contemporary Native American cultures, traditional culture and language are being revitalized. Within this context, it is not too uncommon to find students, as well as their parents, consciously involved in relearning or reviving these aspects of their cultural heritage. Language revitalization, along with a resurgence of cultural identity, will directly affect the perceptions and attitudes of Native American students toward science. Even when a Native American student does not come from a traditional Native American background, the bicultural approach presents important advantages.[19]

Very much like the learning of a new language, the learning of science can provide valuable perspectives concerning the way another culture views nature. The comparison of a particular Native American view of science with that of Western science can broaden students' perspectives of science. It can help all students become

more open and less isolated within the confines of a single cultural viewpoint.

Discovering the Student

Discovering and understanding the student—culturally, socially, and individually—is a first step in implementing a bicultural approach to education. This recognition of diversity is often given "lip service" but is otherwise neglected or poorly represented in the development of curricula. When educators fail to consider students' feelings about a particular approach, they may inadvertently alienate students instead of motivating them. Sometimes, well-intended educators follow models too literally and overemphasize an ideal picture of a cultural group, thereby perpetuating stereotypes not based in reality, or reflecting an outmoded view of the evolving character of a particular cultural group.

Such stereotyping is often the result of relying too heavily on ethnographic descriptions of a culture, while failing to recognize that cultures change and that students within those cultures may have very different views of those cultures than are commonly represented in the literature. While such descriptions provide an important starting point, they should always be tested against reality. And the best way to do this is by facilitating discussion of the kinds of characteristics students perceive as being a part of their culture and experience. The reality of a culture experienced by a student may be a *collage* of values and perceptions that does not resemble very closely the statements in the literature. The student's reality does not negate traditional realities of the culture but exists beside or intertwined with these realities.

Getting reliable information on the cultural characteristics of students is essential to an effective and meaningful implementation of the bicultural education approach. Careful observation of student compositions, informal discussion with students and parents, and involvement with cultural activities within the community are all helpful in developing needed perspectives.

Learning style is a dimension of the interplay of our *insider* and *outsider* realities; it is conditioned by our individual and cultural environments. Learning style has three dimensions: ways of thinking, ways of feeling, and basic inherited tendencies. Of these three

dimensions, the affective, or ways of feeling, is the least well understood, yet, at all stages of learning, it is one of the most influential.[20]

According to Rita Dunn, learning style

> is the way individuals concentrate on, absorb, and retain new or difficult information or skills. It is not the materials, methods, or strategies that people use to learn; those are the resources that complement each person's styles. Style comprises a combination of environmental, emotional, sociological, physical, and psychological elements that permit individuals to receive, store, and use knowledge or abilities.[21]

As stated before, a major reason many Native American students feel alienated from mainstream education is the incongruence between the approaches to and expectations of learning at home and at school. The home learning environment of many Native Americans is characterized by such factors as freedom of movement, learning through direct experience, and hands-on and activity-oriented learning. These learning models emphasize visual, spatial, and kinesthetic orientations. In contrast, in the typical school environment, free movement is significantly restricted and indirect intellectual learning, which emphasizes verbal, mathematical, and logical orientations, is the norm. In some cases, the disparity between home and school environments is so great that Native American students experience a kind of culture shock that significantly affects their attitudes toward school.[22]

Of the many possible behavioral learning styles, none have been isolated as distinctly Native American, but some general tendencies are recognizable. These include a predominantly nonverbal orientation; tendency toward visual, spatial, and kinesthetic modes of learning; heavy reliance on visual perception and memory; preference for movement and activity while learning; and preference for process learning that moves from concrete examples to abstractions.[23]

These tendencies present major implications for science curriculum development for Native Americans. Recognizing that a cultural difference in affective learning style exists between the home and school environment is an important step toward developing more creative and effective teaching strategies for Native American learners. Floy C. Pepper writes the following:

> The basic concept of having instruction fit the real nature of the Indian learner, rather than trying to make the Indian learner fit the school, opens the door to recognizing individual differences, behavioral learning styles and teaching strategies.[24]

The following practices could help teachers get to know their students and successfully implement a bicultural orientation to the education process:

- Explore the student's home and cultural background. This includes such areas as social orientation, parents' expectations of school, parents' educational background, and the student's affective orientations toward home and community.
- Observe students in the school context with special attention to interactions with peer groups, affective emotional characteristics, styles of verbal and nonverbal communication, and predisposition toward specific teaching or learning styles (such as whether they are predominately relational or analytical).
- Explore students' expressions of core values, which can provide insights into their cultural worldviews. The goal is to identify those values that can be focused upon in the development of curricula and that students perceive as relevant to their cultural identity.

The dimensions presented here are preliminary indications of possibilities and considerations of the learner within bicultural education. Each area has been addressed only in general terms. A comprehensive exploration of each area would require a major research endeavor that could enhance an understanding of bicultural education and broaden the realm of possibilities for creative teaching.

Postscript

I began writing this chapter during a period of reflective thought and research from 1982 to 1986 while writing my dissertation. Thus, this chapter is a snapshot of one author's early awareness of an approach to making science relevant to Native American learners by building upon the bicultural background each student brings to school. This has since become a prevalent assumption in current

research regarding ways to improve science education for Native American and other minority students. Today bicultural considerations related to teaching and learning are termed "culturally syntonic variables," defined as "those factors which are in harmony with the normative behavior, values and attitudes of a particular ethnic or cultural group."[25] Culturally syntonic variables include curricula materials, preferred instructional and learning modes, language of instruction, peer interaction, role models, contexts of learning, and interaction with learning materials.[26]

Added to the research on culturally responsive classrooms is the growing literature on creative approaches to scientific inquiry, the multicultural history of science, brain-based methodologies, and constructivism in science teaching. All of these current areas of research reaffirm the essential role of cultural relevance in the teaching of science.

In recent years, Indian education literature has moved away from the notion that Native American learners exhibit a particular type of culturally determined learning style. Instead, the emerging research shows that Native American students reflect all possible modes of learning, but these learning modes are mediated by their particular cultural orientation. Cultural orientation, especially in terms of language, continues to influence the learning and perception of science by Native American learners.

During the dozen years since this chapter was first conceived, the loss of language among Native American youth has increased significantly. Today most Native American students speak only English, though a minority of students still understand their Native languages. Thinking first in their Native language and then translating into English is no longer the case among most Native American students. The reverse—thinking in English and trying to find a word in their Native language that fits—is now the norm. Despite this situation, the influence of a cultural constellation of values is still extensive.

I would like to direct the reader's attention to new work by Native and non-Native scholars that adds much to the thesis of this chapter. For example, recent work by Canadian Native educator Madeline MacIvor, Alaska Native scholar Oscar Kawagley, Hispanic American professor Roberta Barba, and teacher educators Linda Cleary and

Tom Peacock have significantly added to the research base and curricular applications of science and the bicultural learner. In addition, culturally responsive curricula materials are now being produced by school districts, tribally contracted schools, tribal colleges, community colleges, and universities that serve Native American clientele. The popularity among both Native and non-Native educators of "Keepers of the Earth," a series of Native American story-based science curriculum guides by Michael Caduto and Joseph Bruchac, is but one testament to the timely resurgence of cultural relevancy as a factor in teaching and learning science.

Notes

1. Gregory A. Cajete (Santa Clara Pueblo) is an assistant professor in the College of Education at the University of New Mexico. He has taught at the Institute of American Indian Arts in Sante Fe and has lectured nationally and internationally.

2. See Aurbach and Fuchs, *The Status of American Indian Education.*

3. See Anders and Lloyd, "The Significance of Prior Knowledge."

4. See Strum and Purley, "Pueblo Valuing In Transition."

5. Ibid.

6. See O'Malley, *American Indian Education Handbook.*

7. See Ramírez and Castañeda, *Cultural Democracy.*

8. See Pepper, *Understanding Indian Students.*

9. See Cajete, *Look to the Mountain.*

10. See Hyitfeldt, "Traditional Culture."

11. See Lore,"Art as Developmental Theory."

12. See Cajete, *Look to the Mountain* and Kawagley, *A Yupiaq Worldview.*

13. See Cajete, *Science: A Native American Perspective* and Kawagley, *A Yupiaq Worldview.*

14. Ovando and Collier, *Bilingual and ESL Classrooms,* 58-61.

15. Ibid.

16. See Ovando and Collier, *Bilingual and ESL Classrooms.*

17. See Krashen, *Second Language Acquisition.*

18. See Lore, "Art as Developmental Theory."

19. See Kawagley, *A Yupiaq Worldview.*

20. See Pepper, *Understanding Indian Students.*

21. Dunn, "Learning Styles," 5.

22. See Pepper, *Understanding Indian Students*.

23. Ibid., 21.

24. Ibid., 23.

25. Valle, "Cross-Cultural Competence," 30.

26. Barba, *Science in the Multicultural Classroom*, 14.

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